ADP MASTER PLAN

Volume I

January, 1980

Richard D. Lamm, Governor

Lee White, Executive Director

Department of Administration

STATE OF COLORADO

DEPARTMENT OF ADMINISTRATION
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Richard D. Lamm
Governor

Lee White
Executive Director

The Honorable Richard D. Lamm
Governor, State of Colorado
State Capitol Building
Denver, Colorado 80203

Dear Governor Lamm:

Attached please find a copy of the 1980 Automated Data Processing (ADP) Master Plan for the State of Colorado.

The 1980 ADP Master Plan was prepared by the Division of ADP in accordance with CRS 24-30-613. It continues the managed growth approach to ADP which was started in 1977. This approach to managed growth includes consolidation of several computer centers, improved data processing services to user agencies, and simultaneous achievement of efficiencies of operation.

The 1980 ADP Master Plan is published in three volumes. Volume I summarizes the overall status of ADP in Colorado and recommends implementation steps for fiscal year 1980-81. Volume II contains the 1980-81 fiscal year budget analysis. Volume III is a report prepared by the Division of ADP and Department of Revenue staff, which outlines steps to improve data processing in the Department of Revenue.

I ask your endorsement of the 1980 ADP Master Plan and request your permission to continue implementation of the action steps specified.

Sincerely,

Lee White

Lee White
Executive Director

LW/jv
Attachments

Governor's Approval Richard D. Lamm

Richard D. Lamm, Governor

Date 1-16-80

STATE OF COLORADO

DIVISION OF AUTOMATED DATA PROCESSING
Department of Administration

1575 Sherman Street, Room 110
Denver, Colorado 80203
Phone (303) 839-2641

January 16, 1980

Lee White
Executive Director
Department of Administration
7th Floor - State Services Building
1525 Sherman Street
Denver, Colorado 80203

Dear Mr. White:

The 1980 Plan for Automated Data Processing for the State of Colorado (in three volumes) was prepared by the Division of ADP for your approval in accordance with CRS 24-30-603.

The 1980 Master Plan follows the direction that was set by earlier approved plans. It incorporates the recommendations of the interdepartmental task forces. Most importantly, it is a strategy for the near term that directly relates to the statewide budget requirements for FY 1980-81.

Sincerely,

Robert J. Miller

Robert J. Miller
Director

RJM/jv

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

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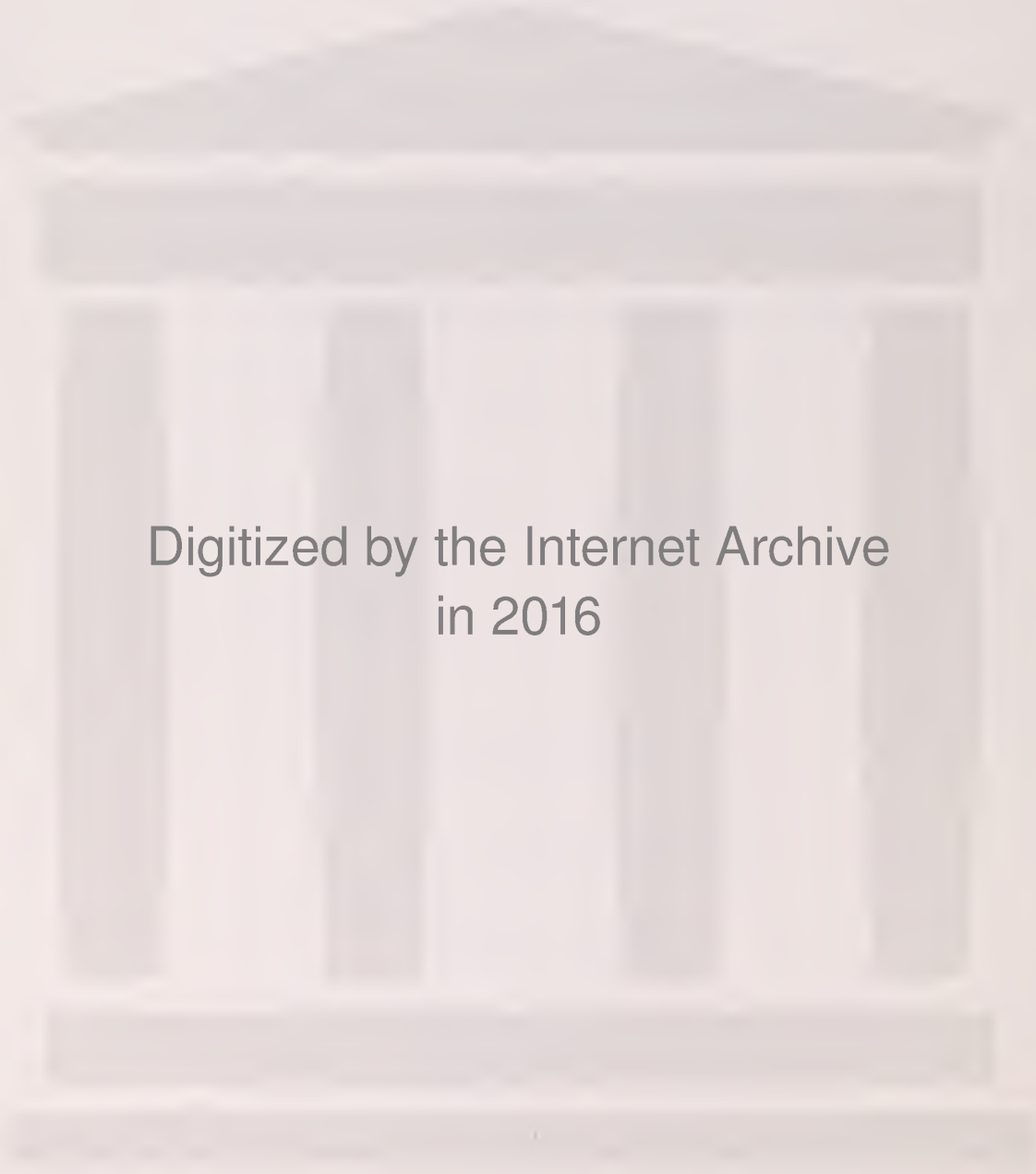


SUMMARY

PREFACE

Previous approved ADP (Automated Data Processing) Master Plans advocated limiting the number of major computing facilities in Colorado State Government because of limited financial resources and the increased need for computing. The ADP Master Plans recommended that shared computing facilities support user agencies' objectives by providing timely data processing and reports. Implementation of earlier recommendations have proceeded to a point where considerable confidence exists in the validity of previous planning efforts. This report, the 1980 ADP Master Plan for Colorado, extends and refines earlier planning.

STATUS OF ADP MASTER PLANNING

Objectives within the current philosophy of ADP Planning have been outlined in previous State ADP Master Plans. These objectives are in various stages of completion which are explained in the 1979 and the 1980 State ADP Master Plans.

FY 1979-80

The State ADP Budget for Fiscal Year 1979-80 recommended funds for the following:

a.	Obtain an uninterruptible power supply system to provide backup power for the General Government Computer Center and the Administration of Justice Computer Center.	Insufficient funds ($100,000) funded for FY 1979-80. Study indicates needed expenditure of $670,000 to complete installation of total UPS System.
b.	Develop a Central Management Information System (CMIS) based on requirements by the State Auditor's Office.	In process of development.
c.	Transfer the computer processing for the Judicial Branch and Department of Law to the General Government Computer Center.	Complete. Expected savings to be $300,000 and a reduction of 3 FTE after first year.
d.	Transfer the computer processing for the Department of Corrections to the Administration of Justice Computer Center.	Complete. Expected cost avoidance of $200,000.

e.	Provide adequate resources for supporting higher education administrative, instruction, and research processing. Funds for establishing the Higher Education Computing Coordinating Group should be requested early in 1979.	In process.
f.	Provide adequate funds for the Revenue Computer Center.	Study to be published as Vol. III of this Plan. Funds identified therein.
g.	Conduct essential personnel training and development programs.	Though funding has been requested numerous times, insufficient or no appropriations made.
h.	Provide distributed processing capability or terminals to identified agencies and establish the necessary communication facilities.	In process.
i.	Eliminate deficiencies in the resources of the Administration of Justice Computer Center.	In process.

SUMMARY OF RECOMMENDATIONS

The 1980 ADP Master Plan recommends that the State continue the implementation of sharing of computing facilities as outlined in the ADP Master Plans of 1978 and 1979 and as revised by interdepartmental studies.

As a result of the implementation of the previous plans and studies, the computing function will center around four computer centers in Denver: General Government Computer Center (GGCC); Revenue Computer Center (RCC); Labor and Employment Computer Center (LECC); and Administration of Justice Computer Center (AJCC). In addition, there will be a computer center in Pueblo; the Institutions Computer Center (ICC). These centers will host the processing of functionally related systems and programs.

General administration and instructional computing facilities serving the Higher Education Community are located at the University of Colorado Medical Center, University of Colorado at Boulder (having 2 centers), Colorado State University, Colorado School of Mines, University of Southern Colorado, Adams State College, Western State College, Fort Lewis College, Mesa College and Pikes Peak Community College.

Smaller distributed processors are located at the Community College of Denver, Pueblo Vocational Community College, Otero Junior College, Trinidad State Junior College, Metro State College, University of Colorado at Colorado Springs, and the University of Colorado at Denver. (See Exhibit A)

Each computer facility should be provided with hardware and software of contemporary technology and sufficient personnel appropriately trained.

Billing rates for the computation of charges to users should be determined fairly using fully-absorbed cost accounting techniques approved by the Director of ADP and the State Controller and consistent with the requirements of HEW and the Department of Labor when Federal Funds are used. Appropriate amortization schedules for each computer center should be established. Users are to be billed for respective computer usage whether or not it is memo billing or cash reimbursement.

During the next several years, various agencies will want more integrated systems, common-use systems, and data bases with multi-agency, multi-application purpose. Wherever feasible, the processing of applications that can be integrated will be accomplished by a single computer center. Each computer center management should prepare for the future of integrated systems by strengthening its personnel training, by enhancing its data base management capabilities, and by planning and expanding its data communication network.

The Director of ADP will provide definitions, parameters and standards for the State's computerized data communications network.

Specialized prewritten application software packages are to be evaluated for possible acquisition prior to major revision of existing in-house systems or creation of new systems. Each department, agency and institution is to encourage sharing of these and other systems where needs can commonly be satisfied.

A great void now exists in knowledge and experience with new technologies. Training of technical personnel in the art and use of current technologies is to take place.

ADP performance evaluation of the numerous State data processing activities is to continue by the Division of ADP with emphasis on application software efficiency and efficacy.

FY 1980-81

The State ADP Budget recommended for Fiscal Year 1980-81 is included in Volume II of this document.

The recommendations reflect the requests of the various departments, agencies and institutions adjusted to reflect the overall State needs in moving forward with the implementation of the ADP Plans.

PREFACE

Annually, the ADP Master Plan is updated in order to reflect new developments and decisions, and to present the short term objectives for funding and implementation.

This section is used to set forth general policies that will be appropriate for ADP activities from year to year. As new policies are developed or existing policies change, they will be within this section. Listed below for information purposes are the current policies in effect and a reference as to where the policy can be located. Many of the older policy statements were originally distributed in the ADP Management Manual.

Policy Subject	Location
ADP Executive Director	Pg. 200-ADP Mgmt Manual
ADP Policies and Guidelines	Pg. 300-ADP Mgmt Manual
Acquisition of ADP Equipment	Pg. 306-ADP Mgmt Manual
Criteria & Requirements for acquiring & using ADP	Pg. 312-ADP Mgmt Manual
Acquisition, use, disposal of ADP resources	Pg. 315-ADP Mgmt Manual
Use of ADP Equipment	Pg. 318 & 405-ADP Mgmt Manual
ADP Planning	Pg. 400-ADP Mgmt Manual
ADP Budget	Pg. 402-ADP Mgmt Manual
Public Access to Public Records	Pg. 407-ADP Mgmt Manual
Mgmt & Coordination of Computer Centers	Vol. 1-1979 ADP Master Plan
Resource Justification	Vol. 1-1979 ADP Master Plan
Common Systems, State Information and CMIS	Vol. 1-1979 ADP Master Plan

Policy Subject	Location
Word Processing	Vol. 1-1980 ADP Master Plan
Computer Facilities	Vol. 1-1980 ADP Master Plan
Application Software	Vol. 1-1980 ADP Master Plan
Data Communications	Vol. 1-1980 ADP Master Plan
ADP Security	Vol. 1-1980 ADP Master Plan

Computer Facilities

Since the publication of the 1977 ADP Master Plan, the State has moved toward maintaining fewer computer centers than were operated at that time. This was accomplished by performing independent studies in which various alternatives were considered and evaluated, with the most effective and economical alternative being selected and implemented. In some studies merging of centers was appropriate and in others the continuation of existing facilities for processing was appropriate and therefore continued.

This direction over the past three years must not be interpreted as centralizing the data processing activity. There is a need for large central processors to fulfill the State's needs for the large integrated systems, data sharing and cost effective availability of generalized packaged applications, easy to use high level languages, and the manipulation of massive volumes of data, which are not available on the minicomputers. The planning direction during this time has also suggested and actively supported the decentralization of systems development and data capture in order to provide local control and responsibility over the accuracy and timeliness of these functions to better meet the requirements of the user. This stimulus is promoting a much closer and direct involvement of users in the activities that impact their future method of operation in fulfillment of their mission. It also provides an initial step in developing data processing expertise within the agencies which would allow them to properly evaluate and plan for possible future uses of automated technology.

Technology in data processing equipment and communications is moving rapidly in the direction of being better able to provide processing capability closer to the actual user. Thus, the actions of the past few years should complement these technological advances by having technical expertise within the agencies to react more readily to users' needs for further management and information analysis.

The need for implementing systems which share data from related sets of programs between two or more data processing centers must be addressed. While this can be accomplished through employing the use of portable storage media, such as a data file captured on magnetic tape or diskette, it is becoming more common to emphasize the use of teleprocessing links to implement this sharing of data. There are a variety of reasons for selecting this approach. All reasons should result in a combination of economic, technical or organizational advantage of one kind or another.

Economic considerations are those of potential savings in areas such as communication costs, sharing of costly hardware, software, and personnel resources, higher responsiveness to new applications, and higher user productivity. Technical considerations stem from the need to reduce response time, to improve availability of information to the end user, and to reduce the complexity associated with single computer centers supporting all applications. Organizationally, the use of communication links provides a vehicle to relate the data processing applications more directly to the organizational structures and information flow. By implementing this strategy of separating and segmenting applications, the impact created by a single computer failure can be reduced.

The approach of providing data processing capabilities closer to the user also dictates a more comprehensive planning direction be undertaken, not only by those managers of data processing facilities but by those end user managers who are directly responsible for the results from processing of the data. Controls and standards take on new meaning in this environment. Standards must be implemented for

communications, software, data base and associated dictionary/directories and programming languages as well as hardware. Selection of applications and their design and architecture within communication networks must be established in an orderly and coordinate manner to realize the potential benefits.

Funding constraints to support ADP should be expected. In order to cope with this constraint there should be an increased appreciation of the production objectives, capabilities, and limitations within all segments of the ADP community. That knowledge should elicit the cooperation for reciprocal services. Facilities should be shared in order to accommodate peak workloads, to avoid excessive procurement, and to avoid duplication of efforts and capabilities.

Application Software

The trend continues in the data processing industry of less cost for computer hardware while the cost of providing computer software, particularly for applications is growing at an accelarated pace. This growth can be contributed to the price that must be paid for computer programmers and systems analysts. The State is experiencing extreme difficulty in hiring computer programmers and the cost of training has greatly increased due to the unbundling of data processing vendors' products and service. The need to develop a nucleus of competent data processors has increased the burden on the data processing managers and those individuals who are responsible for developing and maintaining application software for their user community.

One method of controlling the cost of application software is to program these applications in the higher level computer languages. COBOL, FORTRAN, PL/1, ALGOL, RPGII and more recently PASCAL are being taught in the Business Schools as well as the institutions of Higher Education. The ability to hire personnel with these backgrounds can be a bonus to those responsible for application software. The capability of the higher level languages to be upward compatible within one manufacturer's hardware line and the transferability of applications between computer processing centers to be shared by users with similar requirements without the

cost of full development will also reduce the future cost of application software.

The Division of Automated Data Processing is broadening the statewide policy on the use of computer languages to include not only COBOL and FORTRAN, but also PL/1, ALGOL, RPGII and PASCAL. The use of lower level programming languages is to be discontinued for all new application software development. Those operational systems which have been written in lower level programming languages and require major re-write or conversion are to be re-written in one of the higher level languages. Exception to this policy must receive prior approval of the Division of Automated Data Processing before programming is started.

The sophistication in design of software being used or considered, such as Data Base Management Systems, Management Information Systems, and higher level operating systems, mandates economic justification, feasibility studies, and in-depth planning. Application software has been traditionally developed for one specific operational need of the user. Little or no thought and planning went into the process concerning future needs such as growth and expansion within the system itself, use by others within the user agency, or for coordinating the data between two or more separate application systems to provide much needed information without the redundancy of data entry, programming and operation. The need for coordination of divisional goals and objectives into departmental data processing plans are a must to insure that when money is being expended for the development of application software, the resulting system will provide for as many of the departmental needs as can be identified. This will not be an easy task but those personnel who are responsible for data processing and application software must make the effort.

The sharing of application software between State departments takes on an added significance not only for cost considerations but for informational requirements. A case in point is the recent interest in the use of cartigraphic and demographic information processing to enhance the planning effort to keep pace

with a rapid growing State and the National interest in energy alternatives. The requirements of providing a comprehensive planning tool result in the need to share data that is available in nearly all of the State's departments. Some of this data exchange in the past has been accomplished by transporting data via magnetic tapes, punched cards and printed reports. However, because of inadequate planning, data is many times not compatible with the requirements of the receiving agency which results in additional programming, data entry and other operational costs. The same philosophy presented above concerning application software within a department can be applied to the needs of sharing systems between departments. Planning is again the key issue with an open and broad communications and coordination effort displayed between the participating agencies. The Division of Automated Data Processing will continue to be the catalyst in drawing the various departments together when the need for sharing data and application software is required. The implementation of the communications network for the State will also enhance this sharing of the data and application software package such as SPSS, Mark IV and data base management systems between departments and computer processing centers, thus reducing the cost to all users.

Two sources of application software have been identified above. First, the development of software within a department and second, the sharing of software already developed within the State. There are three other sources of application software that should not be overlooked. Once the requirements of an application are defined and it is determined that there are no compatible applications within the State inventory, these three sources should be researched. The first would be to determine if there are systems available from the Federal and other State Governments. These packages are normally free to other governmental entities or can be acquired for a minimal charge. A second source is the software houses which produce application software on a proprietary basis. Some can be purchased outright or leased (licensed) and installed by the user with their own personnel or with personnel contracted from the vendor. The third, is the consulting or data processing

firms which can be contracted to develop application software. Systems from these sources must be reviewed carefully for maintainability of the software and for modifications necessary to make these packages operational on current State computers.

The lowering of application software costs and providing maintainable systems is directly related to the definition and enforcement of systems development standards. All systems, including data dictionaries and data base management systems, are keyed to success through the use of standards. These standards should not only include the "how-to" technical requirements of defining a system but should show the direction for involving users in the definition and implementation of application software.

Pursuant to statutory requirement, the Division of Automated Data Processing is to approve all new applications software. Normally, this is accomplished during the review of each agency's data processing plan and/or the data processing budget. This process approves the concept of any new systems or major software conversions. A new standard is established in this Statewide ADP Master Plan, which will provide the users and the Division of Automated Data Processing with a formal procedure for the approval of applications systems once the funds for procurement, transfer or development have been received. The standard is structured to provide a description of the systems, the requirements of the system, the operational justification, and the economics of development and operation of the system over its useful life. This standard is included in Section VII of this document.

Common Systems, State Information and CMIS

All future systems requirements should be reviewed to determine their appropriateness for multiple-agency use. To assure consideration of agency, operations, and statewide perspectives, these reviews shall be performed by each agency, the center(s) where service is acquired, and the Division of ADP as a committee.

Also, each agency should review existing applications to evaluate cost effectiveness, efficiency, and sharing potential. The Division of ADP will provide a method for accomplishing this; see Recommendation 7. The

purpose of the evaluations is that of seeking and pursuing cost savings.

Integration of systems and the current project of Central Management Information Systems (CMIS) will provide significant savings and improved information for many agencies. The Director of ADP and each center director or manager should assist any user in pursuing recommendations for systems integration and advise and assist the CMIS committee in obtaining its objectives as requested by the committee chairman.

Data Communications

All future communications facilities should be established in anticipation of a statewide network of shared computer centers. A statewide data communications plan will be developed by the Division of ADP in cooperation with the Division of Communications. The purpose, scope and objectives of this plan are shown in Exhibit B.

Word Processing

It is the policy of the Division of Automated Data Processing that words are data and text is information, and that word processing equipment, staff, and systems which automate the collection, manipulation, and distribution of such information fall within the scope of the Division of ADP's statutory responsibility.

Word processing equipment will be acquired through the same process as any other type of data processing equipment by submitting an authorized ADP Equipment Transaction Request and following the normal Purchasing rules and regulations.

Agencies may contact vendors relative to such items as equipment features, applicability and cost. It is also the responsibility of the agency to develop procedures by which the timely and efficient use of the equipment will result.

ADP Security

As the computer is more heavily used in our information and management functions, the more care we must exercise in assuring that this assistance is not suddenly curtailed due to some unforeseen natural disaster or human impropriety. Because the computer is now a vital part of the processes used in the fulfillment of our various and diversified State programs

and functions, we must concentrate on assuring maximum availability and security of this resource.

The policy, therefore, is that each State agency managing and/or using data processing resources shall develop and implement security procedures, document security plans, and evaluate security readiness. The total security program shall provide an environment within its data processing functions which will protect data, personnel, and physical resources; furnish continuity of critical data processing services; maintain data integrity; and protect confidential personal data.

Each agency shall document its ADP Security measures in an ADP Security Plan which should demonstrate agency compliance to this policy, be reviewed and updated on an annual basis, and be filed with the Division of ADP by March 1 each year.

Periodic agency evaluations of the respective agency security and readiness recovery posture shall take place at least every three years with corrective actions taken on areas of identified deficiencies.

INTRODUCTION

The 1979 Master Plan modified recommendations of previous master plans and proposed a number of new recommendations. These recommendations centered around the original plan for consolidation of some of the 21 computer centers and providing the centers with facilities, equipment, software and personnel that will expand and improve service to all users.

As a result of the recommendations, interdepartmental task forces have examined consolidation of computing resources within the following disciplines:

- Administration of Justice
- General Government
- Labor and Employment
- Institutions
- Revenue

Consolidation within these areas was determined feasible and have been completed or are in process. Significant cost savings and improved processing capabilities are being realized as a result.

In addition, Task Forces are being established in Higher Education to work with the Higher Education Computing Advisory Board and Steering Committee to determine the feasibility of sharing computing resources between Institutions of Higher Education.

This section reviews the progress that has been made in the sharing of computing resources in the various areas. It also outlines the additional effort that must be exerted to complete implementation of the recommendations.

Administration of Justice

Present Status

The Administration of Justice Computer Center serves the Law Enforcement and Correctional communities. The Department of Corrections applications are in the

process of being merged into the computer facility located at the Colorado Bureau of Investigation to form the Administration of Justice Computer Center. This merger is expected to be complete in late Spring, 1980. Judicial applications have been consolidated into the General Government Computer Center.

These efforts have placed all major justice applications in two computer centers located in the same building. This will facilitate the installation of a data link interfacing between the Judicial applications processed at the General Government Computer Center and other Administration of Justice applications processed at the Administration of Justice Computer Center.

A Univac 1100/82 system has been installed at the Administration of Justice Computer Center replacing Univac 418-III computer systems. Modernization of the terminal network is in progress by the upgrade of terminals and gradual development of a hierarchy of terminals. More computer to computer interfaces are being developed. Installation of Digital Data Service is being studied to improve telecommunications capabilities.

Conversion of the Department of Corrections applications transferred from the Department of Institutions Computer Center is nearly complete. A number of enhancements are planned for existing Department of Corrections applications. In addition, the Department is in the process of developing new applications (i.e. Inmate Scheduling/Tracking System).

General Government

Present Status

The General Government Computer Center was formed on July 1, 1978 by the consolidation of the Department of Social Services Computer Center into the Central State Computer Center. In November, 1979, the Judicial Computer Center was merged into the General Government Computer Center, also. These consolidations have resulted in the General Government Computer Center serving numerous additional user agencies and institutions.

The conversion of Judicial applications to enable them to be processed on the IBM 3033 computer system is presently underway. It is anticipated conversion of all programs will be complete in late Spring of 1980.

A new operating system (MVS/JES3) and new programming support system (TSO) have been implemented to improve system performance and reliability, thus improving service to all users.

Current applications at the Computer Center operate in batch, on-line and data base modes. Generally there has been the tendency toward applications moving from batch mode to on-line or data base mode.

A study is in progress to improve data entry service to users. Some of the considerations are: improved standards, task reassignment, new turn around criteria, additional data entry personnel and equipment, and decentralization of functions.

In FY 1979-80, $100,000 was appropriated for the installation of an Uninterruptible Power Supply (UPS). It was felt this was insufficient, therefore a study was made to determine what is available and what would be an appropriate action plan. The study is complete and proposes the installation be made in 3 stages. Total cost over about a 3 year period is estimated to be $670,000.

The General Government Computer Center has established a Customer Relations/Quality Assurance Section. This Section serves as an interface between the Center and the users. The interface is greatly enhanced by the GGCC Users Group which discusses problem areas and general information exchange.

One of their activities, Change Management, ensures that all contemplated changes (hardware, software or procedural) are evaluated and tested, and that such changes will produce a positive, desired effect on performance and availability. Another activity, Problem Management, provides for detecting, recording, defining, analyzing, correcting and maintaining a history of all situations that are inefficient, questionable, or are potentially failure-causing.

Labor and Employment

Present Status

The Department of Labor and Employment is responsible for administering and enforcing the laws pertaining to Workmen's Compensation, employment, social security labor force, and unemployment compensation. The Department is also empowered to hold hearings or courts as necessary to determine actions in disputed cases involving employment, labor and compensation.

The Department is organized in three major divisions; Labor, Employment, and State Compensation Insurance. The divisions are treated separately in recognition of unique informational requirements or data processing structure.

The Division of Labor is provided data processing services by the General Government Computer Center. The Division of Employment and the Division of State Compensation Insurance are provided data processing services by the Division of Employment Computer Center.

Implementation of the integrated Employment Security System, approved in August 1976, has not progressed as rapidly as planned partly because funding requested in the plan was not approved. In addition, communication protocal emulation problems have been encountered during implementation.

Remote data entry for unemployment insurance will permit shifting of the current data entry workload from the central office keypunch unit to local offices and will improve the accuracy of data entered into the system.

Expansion of the system is being accomplished by installation of terminal equipment in newly opened Job Service Centers, the addition of network control and maintenance hardware for system reliability and flexibility, and the purchase of terminals for operational installation of on-line enhancements in additional offices along the Colorado Front Range metropolitan area and in Grand Junction in the heart of Colorado's energy development area.

Institutions

Present Status

The growth in computer processing for the Department of Institutions at the ADP Center located at the State Hospital in Pueblo, Colorado has shown a marked increase the past three years. Data communications and file storage requirements have increased to a level where the Univac 9400-90/60 computer system can no longer maintain an adequate service level to the user community.

The Department of Institutions, in conjunction with the Division of Automated Data Processing, conducted a study during the third quarter of fiscal year 1978-79 to determine the future data processing needs of the Department of Institutions. The results of this study were applied against the processing capabilities of the installed equipment. The major findings of this effort were:

- The current leased hardware would be adequate for two to three years.
- All computer programs and the operating software would have to be rewritten to take advantage of the Univac 9400-90/60 central processor.

It was estimated that a conversion of this magnitude, (700 programs) with the existing developmental staff and on the existing computer configuration would require a minimum of two years to complete. Therefore, the alternative of keeping the current system and converting the applications was rejected.

On May 29, 1979, Sperry Univac presented the Department of Institutions with an unsolicited proposal to upgrade the computer processing capabilities at the ADP center by replacing the Univac 9400-90/60 system with a Univac 1100/61-C1 system and assistance in the conversion effort. The Univac proposal was evaluated and it was concluded that the Univac 1100/61-C1 has the capability to handle the known workload of the Department of Institutions for eight years and that the equipment and conversion cost is within current budget constraints.

The Sperry Univac proposal was validated by the Division of ADP and Division of Purchasing solicited requests for information from other local vendors of computer hardware and software as well as configuring a State owned central processor to answer the Department of Institutions data processing needs. After careful and complete analysis of the submitted information it was verified that the Sperry Univac proposal was in the best interest of the State of Colorado.

Current plans indicate that training and pre-implementation planning was complete in December, 1979, with a conversion beginning at that time on a compatible Univac system. It is anticipated that the conversion will be complete, the system installed and a cutover will be completed the first quarter of fiscal year 1980-81.

The growth experienced by the ADP Center in Pueblo is also reflected in the Electronic Accounting Machine center located at the Fort Logan Mental Health Center in Denver. The volume of cards and the required handling have increased to a magnitude where the EAM equipment must be replaced by equipment of current technology and that can also be used in concert with the Univac 1100/61-C1 at the data center in Pueblo.

It is planned that there will be a request for proposal issued during the third quarter of fiscal year 1979-80 to replace this equipment.

A form of Distributed Data Processing (DDP) is being piloted by the Division of Developmental Disabilities in conjunction with the Client Oriented Data Entry System (CORE). This pilot project employs the concept of local file handling at three of the 22 private Community Centered Boards; Jefferson County, Weld County and one to be determined. This pilot will determine the feasibility of local storage and access of client files and remote key entry, while maintaining Division central files. Datapoint 1500's, attached printers, and CORE application programs have been installed and initial training has been completed.

Depending on the successful results of the pilot project, additional DDP units will be installed.

Datapoint 1800's and associated peripherals are also being installed at the three State-operated Resource Centers and the Division office at Ft. Logan. The Datapoint 1800's will take advantage of the software developed for the 1500's as well as provide for greater in-house processing capabilities, including participation in the State Central Accounting and Personnel Systems.

Revenue

Present Status

Volume III of this plan contains the completed study report written to culminate the extensive study of the current Department of Revenue data processing activities. Status and recommendations concerning the Revenue Computer Center are discussed in detail in Volume III. Basically the recommendations are directed toward the upgrading of hardware, operating systems, and the phased conversion of programs.

Higher Education Administrative and Academic Centers

UNIVERSITY SECTOR

Present Status

University of Colorado (Administrative)

Under approved appropriations the University has installed an IBM 3031 central processing unit (August 1979) replacing an IBM 370-145. This replacement should provide central processing capability to the University for at least 2 to 3 year period.

University of Colorado (Academic)

As of this date no major transitions have occurred at the Academic Center. Indications have been made by the University for changes in both style and quantity of computing resources. No real plan of action has been agreed upon. The current configuration of equipment is a dual CDC 6400.

Colorado School of Mines

Through the regular appropriations process a DEC 2020 system has been installed (October 1979) primarily to support the administrative requirements. A DEC KL10 system will be installed (approximately January 1980) to increase the general academic instructional require-

	ments. Both of these systems are under a 5 year capital acquisition plan. The University also received a large equipment grant from Superior Oil to perform specific sesmic type processing. The equipment (Control Data 720) is presently installed.
University of Colorado (Colorado Springs)	The University presently has funding for replacement of a Remote Job Entry device with a minicomputer system which will provide local interactive instruction as well as continued remote access to the Boulder facility. The administrative support for the Colorado Springs Campus is provided from the Boulder Campus both by remote job entry and on-line terminal access.
University of Colorado (Denver)	The major computing support for both instruction and administration is provided by Remote Job Entry and on-line terminals connected to the Boulder Computing facilities.
University of Northern Colorado	The majority of computing support at the University is supplied by an IBM 370-145. Some interactive instructional support is supplied by Colorado State University via on-line terminals. In exchange the University supplies some remote batch processing to Colorado State. Likewise the University provides instructional computing support to Metro State on a no charge basis. The University recently installed an IBM Series 1 computer, transferred from Pikes Peak, to develop an on-line registration system.

FOUR YEAR SECTOR

Present Status

Fort Lewis College ADP	During the past year, no new software systems were developed for the dated IBM 360/22 computer. Software modifications were implemented as required. Thus, the system/applications were in a maintenance

mode of operation. The majority of administrative time was spent in writing bid requirements for a new computer system and associated software.

In August, a Digital Equipment Corporation PDP-11/70 Computer System was installed, with funds which were appropriated by the Legislature. Included in the computer system were 14 student interactive video terminals and 11 administrative video terminals.

In October, People Oriented Information System for Education (POISE) administrative software was acquired. The POISE software was acquired under a Multi-Institutional award which resulted in up to a 50% discount for the Data Management System DMS license after the first copy, without POISE vendor installation and training. A 25% discount for the DMS license by POISE vendor includes installation and training. The various application software modules acquired include, on-line registration, Student Billing/Receivables, on-line Transcripts, etc., and may be shared, at no cost with other POISE-licensed institutions.

It is anticipated that the IBM 360/22 Computer System will be removed by January 31, 1980, and that the POISE administrative software will be implemented during the Spring of 1980.

Western State College ADP

During the past year, a major new system was installed which substantially improved the accounting for more than 3000 former students, who had National Direct Student Loans. Better formal controls were designed to improve efficiency and to restrict unauthorized access to the computer systems information files. Also a system for providing better control and backup for all computer programs, in the event of fire, theft or a catastrophe in the computer center, was implemented.

More than 500 programs and 18 systems/applications continue to be supported in a maintenance mode of operation.

More emphasis is being placed in developing the Academic and Administrative Users information requirements so that workload projections can be made prior to replacement of dated IBM 360/40 with a State of the Art minicomputer system. Moreover, steps are being taken to

offer training seminars for faculty and administrative users in anticipation of receiving the new computer system.

Mesa College ADP

During the past year, a new computer center director was hired to fill a vacancy caused by disability retirement of the previous director. Major emphasis was placed on researching and documenting the acquisition of a state of the art minicomputer to replace the IBM 360/22 computer system.

In August, a Digital Equipment Corporation PDP-11/70 computer system was installed with funds which were approved by the Legislature. Included in the computer system were 15 student interactive video terminals and 11 administrative video terminals.

An Academic Computing Committee was established representing academic disciplines. This committee should provide the mechanism for acquiring better computing support for the instructional needs.

Conversion of the applicable administrative system/applications from the IBM 360/22 to the PDP-11/70 continues, and hopefully will be completed by early spring, so that the leased IBM 360/22 computer may be released.

In November, the POISE DMS and on-line admissions/registration software was installed, at a discount of 25% for the DMS license.

Adams State College ADP/Computing Update

During the past year, the IBM 360/30 Central Processing Unit (CPU) was replaced with an IBM 360/40 and the applicable modifications were made. Data entry equipment which was being leased from IBM for $549.90 per month was purchased on a contract for a 28 month period, including maintenance, for $543.50 per month. Also, two IBM 029 keypunch machines were purchased (which were fully accrued at Metro) to accommodate increased user demand.

The institution is in the process of recruiting a new Director of the Computer Center. The position will be available after December 1, 1979, and will place more emphasis in the instructional usage of the computing facilities.

Metropolitan State College ADP

During the past year; developed or modified and implemented a Course Level Audit System, Financial Aid System and Academic Record System.

The HP-3000 minicomputer was upgraded to 512 K bytes of memory and capacity for 32 terminal devices.

Jointly assisted the Department of Personnel and GGCC in developing user requirements for a new Personnel System for MSC exempt personnel.

Analyzed, programmed and implemented approximately 100 systems/applications changes requested by users, and maintained some 450 jobs with 1700 computer programs for productions systems.

COMMUNITY COLLEGE SECTOR

Present Status

New computers have been installed at Community College of Denver, (North Campus) and Trinidad State Junior College. A replacement computer has been installed at Pikes Peak Community College.

The new facilities at Pikes Peak and Trinidad are for the primary purpose of interactive instructional support and to provide hardware capability to install and operate the Higher Education accounting system. The Trinidad acquisition replaces obsolete equipment and the new equipment will be used for other institutional processing needs.

The Community College of Denver acquisition will be used primarily for student interactive instruction and to initiate an on-line registration system. Current plans are to employ the on-line registration system at other (if not all) community colleges.

Arapahoe and Denver Community Colleges, through remote access and on-line terminals, acquire most of their computing support from the General Government Computer Center.

Some instruction support is supplied by remote access to Colorado State University.

The released IBM 370/145 from the University of Colorado has been relocated at Pikes Peak Community College.

Otero Junior College and Lamar Community College share a computing facility (DEC 11/34) located at Otero Junior College.

The Pueblo Vocational Community College has installed an IBM Series 1 minicomputer.

INTRODUCTION

This plan modifies the recommendations of the 1979 ADP Master Plan in addition to making new recommendations. The changes and the status of the recommendations are shown below. The recommendations which are underscored are those 1979 recommendations carried over to be a portion of the 1980 recommendations.

Recommendation

THE STATE SHOULD MOVE IN THE DIRECTION OF SHARING COMPUTER FACILITIES TO MAXIMIZE ECONOMIC AND SERVICE BENEFITS.

Recommendation

THE STATE SHOULD ESTABLISH NO NEW COMPUTER FACILITIES UNLESS IT CAN BE DEMONSTRATED THAT THEY PROVIDE UNIQUE STATEWIDE ECONOMIC AND/SERVICE BENEFITS.

Status

Recommendations above have been carried over and not modified.

Recommendation

THE 17 EXISTING COMPUTER CENTERS SHOULD MAINTAIN PRESENT SERVICES TO THEIR USERS PENDING THE IMPLEMENTATION OF RECOMMENDATIONS IN THIS DOCUMENT WHICH WOULD AFFECT THEM.

Status

The consolidation of the Judicial Computer Center into the General Government Computer Center has been completed and results in 17 major computer centers across the State. The concept of the sharing of computer resources will continue to be stressed. (See Exhibit A)

Recommendation

STANDARD SERVICE LEVELS SHOULD BE DEVELOPED FOR EACH SERVICE CENTER AND SUBMITTED TO THE DIVISION OF ADP FOR APPROVAL. THESE SERVICE LEVELS SHOULD BE USED IN DEVELOPING COST/BENEFIT ANALYSIS FOR NEW SYSTEMS.

Status

Recommendation has been carried over and not modified.

Recommendation

ALL DEPARTMENTS, INSTITUTIONS, AND AGENCIES WHICH USE OR ANTICIPATE USING AUTOMATED DATA PROCESSING SHOULD FURNISH LONG RANGE ADP PLANS TO THE DIVISION OF ADP BY APRIL 1 OF EACH YEAR.

Status

This recommendation has been modified. However, a number of agencies and institutions have not submitted updated ADP Plans since the 1979 Master Plan was published. (See Exhibit C) Plans received by the Division of ADP and the respective dates are:

Arapahoe Community College	1/79	
Dept. of Regulatory Agencies	1/79	
Lamar Community College	2/79	
Community College of Denver	3/79	
Division of Labor	3/79	
Mesa College	3/79	(Update)
Dept. of State	3/79	
Div. of Automated Data Processing	4/79	
Colorado Bureau of Investigation	4/79	
Dept. of Corrections	4/79	
Dept. of Education	4/79	
Fort Lewis College	4/79	(Update)
Dept. of Highways	4/79	
Dept. of Natural Resources	4/79	
Dept. of Personnel	4/79	
Div. of Property Taxation	4/79	
Dept. of Health	6/79	
Dept. of Revenue	6/79	
Div. of Planning	11/79	

Recommendation — THE PROCESSING FOR THE JUDICIAL BRANCH AND DEPARTMENT OF LAW SHOULD BE TRANSFERRED TO THE GENERAL GOVERNMENT COMPUTER CENTER DURING FISCAL YEAR 1979-80. CONVERSION OF THE JUDICIAL APPLICATION PROGRAMS WOULD BEGIN DURING FOURTH QUARTER, 1979.

Status — Equipment transfer has been completed. The equipment is functioning under DOS environment using the unmodified application programs. Conversion of the applicable programs to native OS and migration to the IBM 3033 computer under MVS will be complete in the Spring of 1980.

Recommendation — THE PROCESSING FOR THE DEPARTMENT OF CORRECTIONS AND DEPARTMENTS OF LOCAL AFFAIRS SHOULD BE TRANSFERRED TO THE NEWLY ESTABLISHED ADMINISTRATION OF JUSTICE COMPUTER CENTER.

Status — The transfer recommended is being completed.

Recommendation — PROVIDE AN UNINTERRUPTIBLE POWER SUPPLY SYSTEM FOR GENERAL GOVERNMENT COMPUTER CENTER AND ADMINISTRATION OF JUSTICE COMPUTER CENTER.

Status

Recommendation has been carried over and not modified. In the FY 1979-80 budget request, $150,000 was requested for the purchase and installation of an uninterruptable power source. Only two-thirds ($100,000) was funded. Being hesitant whether or not this amount was sufficient, due to delays and inflation, etc., to cover the total cost, management authorized a study, which is now complete, to determine the sufficiency of funding. A decision is now to be made regarding which phase or option to pursue as recommended in the report. Action will be taken based on the decision.

Recommendation

STUDY AND DETERMINE SPECIFIC ADMINISTRATIVE APPLICATIONS FOR COMMON DEVELOPMENT BY INSTITUTIONS OF HIGHER EDUCATION AND DIVISION OF ADP.

Status

This recommendation has been carried over and not modified.

The IAI Accounting/Accounts Payable system has been established at the General Government Computer Center for use by all community colleges. Community College of Denver and Arapahoe Community College have implemented the system. The current plan is to bring Lamar Community College, Otero Junior College, Trinidad State Junior College, Pikes Peak Community College and Pueblo Vocational Community College into the system by July 1, 1980.

A Library Circulation Control System has been established at the Auraria Higher Education Center, operated by the University of Colorado at Denver. The University of Colorado Medical Center Library was brought into the system in FY 1978-79. Budget requests for equipment at Community College of Denver, North and Red Rocks campus libraries, was not funded in FY 1979/80. Colorado School of Mines and Pikes Peak Community College libraries will join the system during FY 79/80. All institutions of higher education should study this system for applicability in the respective institutional library. The planning, funding and equipment requirements should be coordinated with the Division of ADP.

The central personnel system is being modified to meet the requirements for Metropolitan State College. This

modified system may be extended to other State institutions of higher education if successful operation occurs at Metropolitan State College.

The concept of systems sharing has always been in existance in higher education but should be actively pursued as a means to defray development costs. Systems sharing should always include the alternative of operating any software package at a host computer site as opposed to transfer of the software to a local site.

A registration system is being developed at the Community College of Denver to be implemented at other Community Colleges if practical and economically justified.

Recommendation — IMPLEMENT RECOMMENDATIONS OF THE HIGHER EDUCATION CONSORTIUM STUDY GROUP IN JULY, 1979.

Status — A preliminary Higher Education Task Force Study submitted to the legislative Joint Budget Committee in January, 1978, resulted in a supplemental appropriation to conduct an indepth study of issues in Higher Education computing matters.

The appropriation provided the means to employ EDUCOM, an outside consulting firm specializing in higher education. EDUCOM completed the study in late 1978 and the report was submitted to the legislature in January, 1979. The report was published as Volume III of the 1979 ADP Master Plan titled, "Computing in Colorado Higher Education...A Review with Recommendations", and proposed many detailed recommendations for which the following general status is provided.

EDUCOM Recommendations — CHANGES SHOULD BE MADE IN THE METHOD IN WHICH BUDGETING AND FUNDING FOR COMPUTING IS ADMINISTERED.

Status — No specific action has been taken.

EDUCOM Recommendation — A NON-PROFIT MARKETPLACE FOR THE SHARING OF COMPUTING RESOURCES AMONG INSTITUTIONS SHOULD BE PROVIDED.

Status	Within appropriation limits no generally accepted practice has been developed to accomplish the intent of this recommendation.
EDUCOM Recommendation	CORRECT SERIOUS RESOURCE DEFICIENCIES BY REPLACING THE UNIVERSITY OF COLORADO ADMINISTRATIVE COMPUTER.
Status	Through the regular budget process and the subsequent appropriation for FY 79/80, funds were made available for this purpose. A new central processor was installed at the University in August, 1979.
EDUCOM Recommendation	REPLACE OBSOLETE EQUIPMENT
Status	Due to sufficient funds being appropriated, new computers have been installed (August and September, 1979) at Trinidad State Jr. College, Ft. Lewis College and Mesa College. Adams State College and Western State College equipment replacements as recommended in the study did not occur in 1979. It is perceived that requests to the legislature for these replacements will be forthcoming within the next two years. Any replacements may very well be dependent on other legislative or executive action regarding the change in mission of certain institutions of higher education. Through a displacement process the State-owned IBM 370-145 computer was relocated from the University of Colorado to Pikes Peak Community College. The displaced IBM 360-40 computer from Pikes Peak Community College was relocated to Western State College. The latter placement is considered as a short term, minimal upgrade, providing increased capacity of existing equipment, with no additional needed capabilities.
EDUCOM Recommendation	FORM A SEPARATE ORGANIZED HIGHER EDUCATION COORDINATING GROUP UNDER A DIRECTOR OF THE DEPARTMENT OF ADMINISTRATION AND SEPARATE FROM THE DIVISION OF ADP.
Status	With the consent and advice of the Association of Public Colleges and University Presidents, the intent of this recommendation has been implemented within the Division of ADP by allocating the equivalent of

3.0 FTE to the coordination of higher education computing matters. This has been accomplished within existing staff and budget.

EDUCOM Recommendation

FORMULATE AN ADVISORY BOARD COMPOSED OF A HIGH LEVEL REPRESENTATIVE FROM EACH INSTITUTION OF HIGHER EDUCATION TO ADVISE THE COORDINATING GROUP AND THE EXECUTIVE DIRECTOR OF THE DEPARTMENT OF ADMINISTRATION ON ALL MATTERS PERTAINING TO COMPUTING PLANNING, BUDGETING AND MANAGEMENT WITHIN THE COORDINATING RESPONSIBILITIES OF THE GROUP. AN EXECUTIVE COMMITTEE SHOULD BE APPOINTED FROM REPRESENTATIVES ON THE BOARD. BY-LAWS SHOULD BE DRAFTED. THE WORK OF THE COORDINATING GROUP SHOULD BE CARRIED OUT THROUGH THE INITIATION OF TASK FORCES MADE UP OF PERSONNEL FROM THE INSTITUTIONS OF HIGHER EDUCATION.

Status

Through the cooperative initiative of the Executive Director of the Department of Administration, the Association of Public Colleges and University Presidents and the Association of Community College Presidents, the formulative process for all of the aforementioned recommendations has been implemented. A representative of each institution of higher education was appointed to an advisory board by the respective president. The board held its first meeting on April 19, 1979. The first important matter to be resolved was the formulation and acceptance of a charter (by-laws) for the board. The second matter was the option to create a steering committee, which was exercised. The appointment to the Steering Committee (Executive Committee) from membership on the board, is comprised of one representative from the group of colleges duly constituted by legislated board, i.e., Board of Community Colleges, State Board of Agriculture, University Regents, etc. The Steering Committee is therefore comprised of six (6) member representing the six institutional boards. A representative from the Division of ADP serves as ex-officio member and secretary to both the Advisory Board and the Steering Committee.

The Steering Committee held its first official meeting on May 4, 1979. Subsequent to these initial meetings, the Advisory Board has met once and the Steering Committee has met four times. A Task Force has been

created by the Steering Committee to formulate a Higher Education Computing Plan to be published in late Spring, 1980. A chairman of the Task Force has been appointed and the initial stages of these efforts has begun.

EDUCOM Recommendation

CREATE LEGISLATION TO ESTABLISH A GOVERNANCE STRUCTURE AND CREATE CHANGES IN FUNDING AND BUDGETING PROCEDURES, I.E., REVOLVING FUNDS AND RECOGNITION OF A SIMILAR ORGANIZATION AS FOUND IN HOUSE BILL 1725. THE STRUCTURE TO BE SIMILAR IN NATURE TO THE BI-CENTENNIAL COMMISSION OR THE AURARIA BOARD.

Status

There is general consensus within higher education institutions and with the Division of ADP that pursuit of this recommendation would not be frutiful.

COMMUNICATIONS

Recommendation

STUDY THE DATA COMMUNICATIONS REQUIREMENTS OF STATE AGENCIES AND INSTITUTIONS OF HIGHER EDUCATION AND DEVELOP A STATEWIDE DATA COMMUNICATION PLAN.

Status

Recommendation has been carried over and not modified. This recommendation is in the process of being implemented. The definition of communication requirements on a statewide level is continuing, after which network designs and proposals will be included in a final Statewide Data Communications Plan. This should occur about mid 1980.

PREFACE

Developing and maintaining the ADP Master Plan is a continuous activity that requires a great amount of information from all departments, institutions, and agencies. Much of that information can be and is collected from the agencies in the form of their plans, budget requests, resource justifications, project evaluation sheets, etc. The agencies' documentation alone, however, cannot assure that the State is meeting the ADP needs of each agency -- direct contact with the agencies is essential.

One of the most important of the on-site contacts is the ADP/Computing Performance Evaluation; this is one of the contacts in which a sufficient length of time is allocated for an overall look at an agency's ADP needs and capabilities. The evaluation reports are provided to the Governor and the General Assembly for information as well as to agency management for appropriate action and follow-up.

ADP evaluations are discussed in this section to promote a better appreciation of the evaluation program among the agencies, executives, and the General Assembly, and to demonstrate the importance of the evaluations in the planning effort.

AUTHORITY

ADP Performance Evaluations are conducted in accordance with the below quoted statutes of CRS 1973, as amended,

24-30-102 (1) (A) "Study and make recommendations to the Governor regarding improvements in techniques used by State agencies for management specialties, including, but not limited to,..data processing management."

24-30-603 (1) (j) "Continually study and assess the data processing operations and needs of State departments, institutions and agencies."

SCOPE

The ADP/Computing Performance Evaluations function encompasses the analysis and assessment of the total automated data processing/computing activities of

Agencies, Departments, and Institutions. These activities include:

- Systems and applications
- Utilization of products, services, personnel and equipment
- User information needs and resources
- Control exercised over the ADP/Computing activities
- Management policy with respect to the ADP computing operations.

CURRENT STATUS

During the fiscal year 1978-1979, evaluations were completed for:

- Adams State College
- Mesa College
- Fort Lewis College

Within the latter two evaluations, 30 recommendations were made for improvement in the total ADP/Computing activities. Agency responses to the recommendations were included in the published reports and indicated concurrence with 28 of the recommendations. The majority of the 28 recommendations had been completed or were being implemented at the time of receipt of the institutions responses.

Copies of the evaluation reports are available at the institutions and at the Division of ADP.

SCHEDULE

During fiscal year 1979-80, evaluations will be conducted at:

- General Government Computer Center
- Trinidad State Junior College
- Lamar Community College
- Otero Junior College

These evaluations will be conducted as time and resources are available. Also, as time and resources are available, follow-up reviews will be conducted for:

University of Colorado
Western State College
Adams State College

In fiscal year 1980-81, the remaining Community Colleges will be evaluated along with Metro State College and the Department of Education. The evaluation cycle will also begin with the State agencies having been evaluated least recently. Stronger emphasis will be placed on systems, applications, and personnel effectiveness while less emphasis will be placed on the routine equipment and operational aspects.

RESULTS

The evaluations provide the Division of ADP, the Legislature and other interested parties with the status, problems and plans for ADP within the State agencies and institutions. This information is used by the Division of ADP in developing budget recommendations, assessing equipment acquisition requests and developing the State of Colorado ADP Master Plan.

The evaluation process is able to determine the effectiveness of automated systems from the user's point of view. This determination is communicated to the ADP organization and top management with recommendations for improvement. Changes to systems are made in accordance with these recommendations.

In those agencies where user involvement in systems development and priority setting has been lacking, the recommendations have led to the reactivation or initial establishment of user advisory committees. These groups improve effectiveness of systems and the aligning of resources to agency goals and priorities. Policy and Advisory Committees are being established at many campuses as a result of the evaluation team's recommendations.

The evaluations stimulate the establishment of uniform standards and the upgrading of programming, systems

and user documentation. Many agencies are reviewing their user manuals with a view to simplification where feasible and beneficial. The establishment of due dates, checkpoints and milestones for all projects is encouraged in order to assure more effective use of personnel.

Numerous operational improvements have been made in computer centers as a result of recommendations of the evaluation process.

As part of the evaluation, the utilization of equipment is analyzed. The Division of ADP purchased a TESDATA hardware monitor to be utilized in computer performance measurement. This device measures utilization of the various computer components. In addition, it measures individual usage of various features of each of these components.

Performance improvement is not a new discipline in the data processing industry. Systems programmers have been improving the performance of computer systems for many years. Their primary technique has been insight. They intuitively identify areas of inefficiencies relying sometimes on basic performance evaluation tools to clarify the extent and effect of the problem. The hardware monitor provides a tool that will measure the time utilization of a system.

The evaluation process uses the hardware monitor to measure system performance extensively. It has been used in conjunction with performance audits; to assess workload on systems approaching their maximum processing capacity, to isolate hardware and software failures which were causing system degradation, and to balance utilization of channels and devices on a system.

BACKGROUND

The 1979 ADP Master Plan presented a background and history of the evolutionary changes of computers and their uses. Today, the evolutionary changes are occurring at a more accelerated rate than ever before, not only in the computer industry but also in the data communications industry. These changes and advancements are continuing to reduce acquisition and operation costs, increase processing speeds up to 1 million times faster than the first generation equipment, miniaturize storage of vastly greater capability, and produce data transmission capabilities far exceeding anything in the past.

These advancements are impacting the data processing management philosophies in many corporate, private, and government entities including the State of Colorado. The philosophies of centralization and decentralization are assuming a new dimension; that is, utilizing the advantages of both in distributed data processing. Distributed processing of course would be augmented by stand alone computers as application and circumstances dictate.

Distributed processing allows the user to take advantage of the reservoir of information at the central site while "off loading" the central computer by moving some of the processing workload to those locations where it may more logically and economically belong. Distributed processing provides a balanced approach: necessary control of the central location along with new flexibility for the end user.

The primary goal of distributed processing is to obtain improved service at lower cost through resource sharing. The concept of using minicomputers and special purpose computers is to place processing power at points where the data is generated or where the data is needed for supervision or management.

It is no longer economically feasible for each major user to have their own standalone central processor as they did in the 1960's with the small standalone systems. Distributed processing provides users with

the advantages of standalone systems while providing easy access to large data files, extensive computer power and the numerous other advantages of processing at a central site.

In contrast to the pace of innovation elsewhere computer printing technology, until recently, has been remarkably stable. But significant change is underway. For example, non-impact printing technologies have already appeared in products like the IBM 3800, the Xerox 9700 and the Honeywell Page Printer. The main virtue of these so far has been high speed. They use the concepts of laser drum transfer, copier drum transfer or direct imaging. These technologies are complex because they are not constrained to a single font as impact printers are; any character of varying sizes, any graphic image, any logo, any color if needed, are all available. In economic terms, with the cost of computers decreasing, paper prices increasing and conventional printout hardware achieving only modest price reductions, the printout function assumes new prominence as a cost element in the total system budget.

It is projected that the computer printout output volume will more than double during the next 10 years. There will probably be no future increase in impact printer speed because the technology of a mechanical print device does not lend itself to increasing the speeds much above that of existing products on the market.

Cost of printing supplies (especially paper) will continue to increase resulting in a need for:

1. More data compaction
2. Printing on both sides of paper
3. More system control
4. Continued reduction in operator intervention
5. Further cost performance improvement
6. Use of computer output microfilm

Data base applications require large amounts of data available with minimal access time. This results in the file storage system becoming much more critical.

There are new technologies being developed for file storage such as charge coupled devices, magnetic bubbles, electronic beams and holograms. However, new models in magnetic disk systems are also under development. It appears that the present packing density of data on a disk can be increased by perhaps a factor of ten. A disk drive which is capable of holding 400 million characters of data, representative of today's state of the art, might contain four billion bytes in the future. Thus, the unit cost of disk storage will become very low, and the new technologies mentioned above are not going to be able to match the cost for at least ten years. The disk will remain the file storage medium of choice for the near future.

However, that means the access arms still have to be moved which is a slow process. Fortunately, the arm movement problem can be solved by providing a large fast buffer store and employing the same principle utilized in cache memory. Buffered disk systems with intelligent controllers that manage the device complex as if it were all a homogenous file will likely be offered by a number of vendors.[1]

HARDWARE RELIABILITY

One result of State government's dependence on data processing for its operation will be an increasingly stringent demand for reliability and availability of data processing capabilities. Hardware reliability will improve because of the inherent characteristics of the technology, architectural changes, and increased sophistication of the maintenance process. Emphasis will be on the availability of the entire data processing system. It is expected that some of the future hardware cost/performance improvements will be used to overcome the current shortfall in hardware reliability.

Redundancy may be the route to better reliability. Some vendors provide redundancy by designing a computer with three of every circuit and hardware logic for a majority vote on every function performed If one circuit is out of step with the other two, the logic accepts the answer from the two and assumes that the third circuit failed. Other vendors offer an option of fail-safeness through a continuous diagnostic procedure.[2]

Catastrophe prevention measures and recovery capabilities become essential as data processing is integrated into the main line of State government. Proposed hardware and software changes will be scrutinized carefully; certainly by the center manager and in some cases by the end user for impact on service, even if the changes promise substantial economics.

DATA PROCESSING INDUSTRY TRENDS

The data processing industry will continue to double in dollar volume every five years worldwide from 1975 thru 1990.

It is expected that total user spending on data processing in the United States will increase from 2.1% of the Gross National Product (GNP) in 1970 to 13% in 1990 and from $101 per capita to $1,253.

As many as one in five of the United States labor force will require some knowledge of data processing by 1990. In addition, more than six out of ten in the United States labor force will depend in some way on data processing by that date. A larger and larger percentage of the cost of data processing will be attributed to personnel costs.[3]

More sharing of large mainframes is evident along with the uses of data base management techniques. This seems to be an industry-wide trend.

Purchased or prewritten specialized application software packages are becoming common place within the industry.

Explosive growth is expected in the area of communication based computer systems for the next few years. Leading experts project a growth rate of 25% for communications equipment and a decrease in transmission cost by a significant amount each year. Because of this, many organizations are planning to develop and expand their communication capabilities.

Users of data processing equipment and those who write application software are anticipating the introduction of a new programming language. Several factors contribute to this anticipation, such as; rapidly decreasing equipment cost, increasing equipment capability and

reliability, increasing personnel cost, and the need for a higher level more machine independent language. This anticipation lends itself to languages oriented toward problem solution, and not toward merely instruction to the computer; that is, the programmer will concentrate on specifying what is to be done rather than how to do it. The programmer would specify the solutions allowing the compiler to choose appropriate algorithims and data structures similar to the way a sort/merge chooses an appropriate sorting routine.[4]

INTRODUCTION

This section contains only those cost and performance standards which are pertinent to the ADP Master Plan, support its objectives and recommendations, and are proposed for adoption statewide. Currently adopted standards are published in the State Automated Data Processing Management Manual.

OBJECTIVE

The objective is to establish standards for ADP management, planning, applications development, equipment management, and performance evaluations. The standards should specify levels of service which should be provided by computer centers to their customers in order for them to receive the necessary support for their programs at reasonable cost. Such standards will provide consistency in the review of budgets and resource acquisition requests.

CURRENT STATUS

The State ADP Management Manual is organized in seven volumes:

Volume	Title
One	ADP Administration Includes statutes, executive orders, policy, agency planning, statewide planning, Federal Information Processing Standards and Security.
Two	ADP Financial Management Includes budget analysis, project analysis, and other financial standards.
Three	ADP Applications Management Includes standards to assure quality through the various stages of design, implementation, and post implementation evaluation.
Four	ADP Personnel Management Includes training of ADP personnel.
Five	ADP Equipment Management Includes acquisition procedures
Six	ADP Facilities Management (To be published)

Volume	Title
Seven	ADP Evaluations (To be published)

The use of these standards provides certain advantages:

1. Easier transferability of systems between agencies,
2. Better communications between agencies, and
3. Reduced effort in maintaining various systems manuals.

Recommendations for revisions or new standards should be submitted to the Division of ADP.

Standards for the preparation of agency and computer center ADP plans are contained in Exhibit C.

STANDARD SERVICE LEVELS

The following performance standards were published in the 1977 Master Plan. They should be used pending recommendations from interdepartmental task forces or directors of each computer center.

- Prime Shift - 8:00 AM to 5:00 PM (95% reliability)

  Priority 1 - On line (interactive) applications where full time operators are employed whose high productivity would be lost by poor response time (less than 5 seconds acceptable).*

  Priority 2 - On-line inquiry applications where citizen information is being retrieved for agency and/or citizen inquiry and interactive program development (less than 10 seconds acceptable).*

  Priority 3 - On-line inquiry applications for management information (less than 20 seconds acceptable).

  Priority 4 - Remote and local batch production jobs that require prime shift processing (1 hour plus processing time)

Priority 5 - Inquire by counselors, auditors, etc., for conduct of daily business (less than 45 seconds acceptable).

Priority 6 - Remote and Local Student Batch Jobs

- Students in beginning courses (less than 15 seconds acceptable).
- Students in advanced courses (less than 1 hour acceptable).

Priority 7 - Remote and local batch program compiles and tests (less than 1 hour plus processing time, with 90% reliability. (More than 1 hour increases programming labor costs).

*Interactive program development should be discontinued during periods when it inhibits the attainment of response time in priority 1 or 2.

- Second and Third Shifts (99% reliability)

Priority 1 - All on-line (interactive) processing with same response time as prime shifts.

Priority 2 - All regularly scheduled batch production jobs - by 8:00 AM

Priority 3 - Reasearch oriented jobs - by 8:00 AM

ADP SECURITY

ADP Security Plans shall be prepared by all State agencies and educational institutions operating data processing equipment, using, or providing data processing services. Each agency is ultimately responsible and accountable for its security program even though it may acquire data processing services external from the agency.

Agencies using external services shall implement internal security programs, identify requirements, and negotiate implementation of security measures with the provider of services. Providers of services shall implement and provide to their users security measures, as negotiated, consistent with these standards. Sensitive elements of the plan shall be

retained at the agency and referenced in the plan filed with the Division of ADP.

The ADP Security Plan will require an annual review and must be updated and filed with the Division of ADP whenever the data processing environment undergoes a significant change. Security plans must contain enough information to enable management to ensure proper safeguards for human life, data processing assets, confidentiality of personal data, and that continuity of data processing services and products can be provided.

ACQUISITION OF APPLICATION SOFTWARE

The Division of Automated Data Processing is statutorially responsible for the review and approval of all existing and new software applications which support the data processing requirements of all agencies of the State of Colorado. The philosophies and recommendations in this plan are totally congruent with the legislative intent of the statute. That is, through a review and approval process more sharing is promoted and less expenditure is needed for software. This process is also another refinement in determining the need for and adequacy of the proposed software.

The ADP Management Manual is currently being updated to include a standard for the acquisition of application software. This standard includes such topics as:

- Methods of requesting acquisition approval
- Sources of software
- Documentation
- Definition and justification
- Impact and sensitivity analysis
- Procedure in pursuing the software approval/ acquisition requirements.

This standard is complementary to the actions which will occur as a result of implementing recommendation 8.

FUTURE STANDARDS

Standards for the centers proposed by the ADP Master Plan will be developed out of the proposals of the inter-departmental task forces, as each center is activated.

Additional standards will be developed, as necessary to provide for user agency participation in such things as the selection of hardware or software for the center.

Insofar as possible, however, the standards should be applied statewide, and not just center by center. The State ADP Management Manual provides an open-ended vehicle for this purpose, and should be utilized.

CONCLUSIONS

The recommendations of the 1979 and 1980 Master Plans, as approved by the Governor should be pursued. The 1979 recommendations are updated as indicated in Section IV, while the 1980 recommendations are contained in this section. Exhibit D depicts a proposed implementation schedule for these recommendations and activities.

RECOMMENDATIONS

- Recommendation 1 - Investigate and acquire, if applicable, prewritten software packages for all new applications or existing applications which are to be heavily modified. These systems should also be considered as candidates for sharing.

  The purpose of this action is to expedite implementation of systems while expending less money.

  The Division of ADP will be available to assist departments and agencies, including higher education in the selection of common systems. Included would be systems such as student registration, student loans, accounts receivables, accounts payable and student records.

- Recommendation 2 - Each department and Agency of the Executive Branch should encourage and participate in determining what application systems can be shared, and pursue methods of actually sharing these systems.

  Common systems have proven to be advantageous in many respects. These advantages include lower total acquisition expenditure, greater maintainability, and fewer support resources required. Increasing movement in this direction has taken place recently and should be continued.

- Recommendation 3 - Accelerate technical training for programmers, analysts, computer operators and system software personnel.

  Technology advancements in the data processing industry are occurring at an alarming rate. In order to take full advantage and to maintain a state of the art posture, personnel must be trained to proficiently utilize these new techniques.

- Recommendation 4 - Adopt and implement recommendations contained in the "Revenue Data Processing Task Force Study" report.

  This report, included as Volume III of the 1980 ADP Master Plan, has many significant recommendations to be phased over a period of years.

- Recommendation 5 - Complete the conversion/migration of the Department of Corrections data processing to the Administration of Justice Computer Center, from the Department of Institutions computer center in Pueblo.

  This is now in progress and is to be completed per revised schedule.

- Recommendation 6 - Review in FY 1980-81 the feasibility and impact of absorbing MMIS into the State from the contracted fiscal agent.

  The fiscal agent contract is of 2 year duration. At the end of the current contract it may be beneficial for the State to service the MMIS program.

- Recommendation 7 - Develop and initiate on a statewide basis project evaluations of current software applications.

  Each department, agency, and institution will be expected to report justification of and cost/benefit realized for each application and associated software. The Division of ADP will review the reports and take whatever action necessary, in concert with the respective entity, to effect savings on a statewide perspective.

- Recommendation 8 - Study the data entry needs of the agencies in the Capitol Complex area.

  This is needed not only from an identification viewpoint but also from the cost/benefit and serviceability viewpoint.

RECOMMENDATIONS

It is recommended that the implementation activities described in the conclusions above be approved, and that sufficient funds be appropriated in Fiscal Year 1980-81 for their accomplishment.

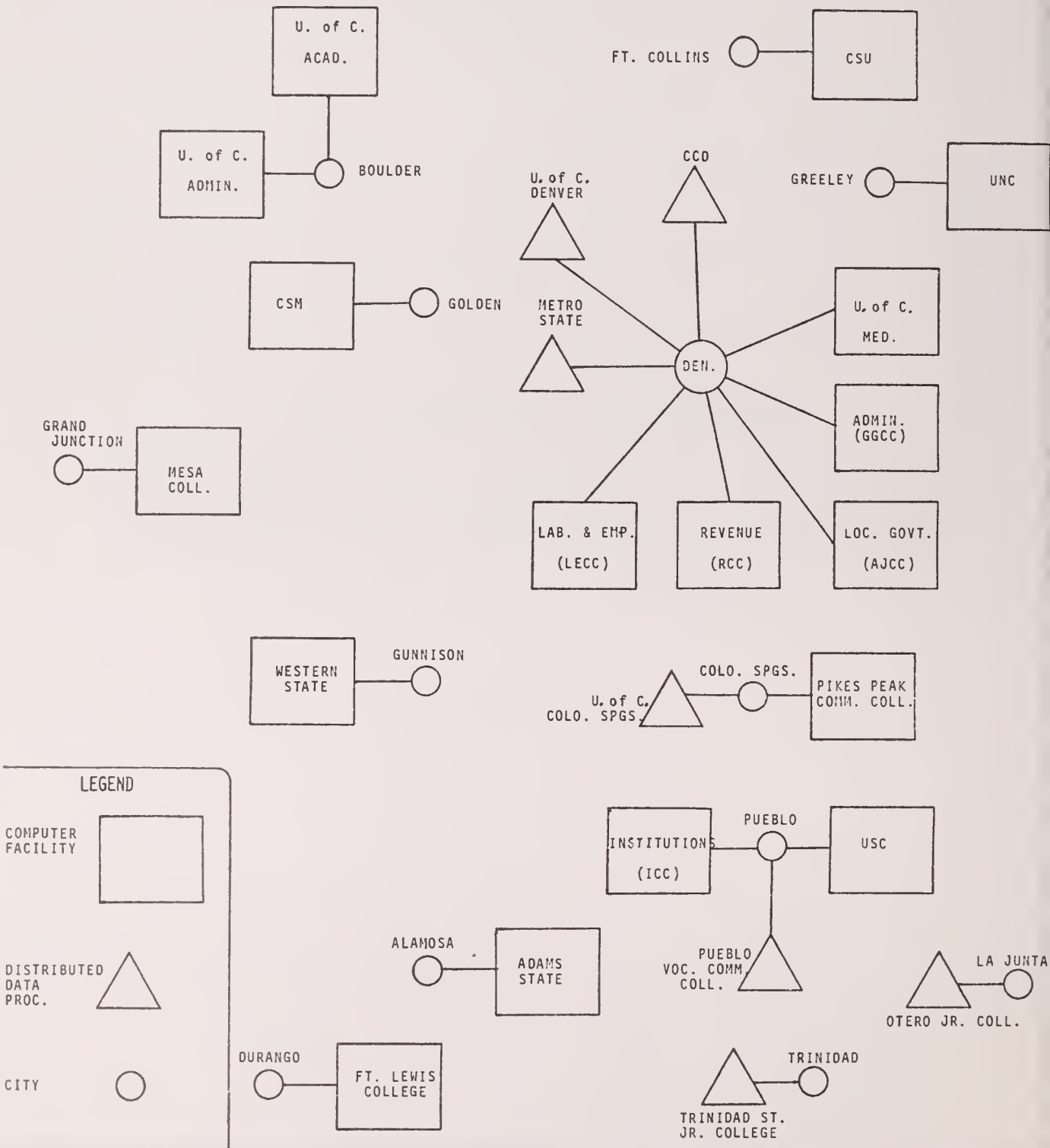
EXHIBIT A

REPRESENTATION OF EXISTING COMPUTER CENTERS

This representation depicts the existing 17 computer centers and the locations of distributed data processing equipment locations. Merging of the Judicial and Corrections computer centers into other existing computer centers and the reclassification of other locations has resulted in the level counted at 17 centers.

EXHIBIT A

REPRESENTATION OF EXISTING COMPUTER CENTERS



Status of the Statewide Data Communications Plan

This document provides the status of the Statewide Data Communications and developes some short range data communications plans based on those facilities which will be available during the next year within the State of Colorado.

EXHIBIT B

STATUS OF THE STATEWIDE DATA COMMUNICATION PLAN

HISTORICAL

Colorado State agencies and institutions computer networks have grown from several hundred terminals in the early 1970's to well over one thousand by the end of 1979. These networks provide service for many different types of user requirements and utilize a large mix of different vendors' equipment and related network control techniques. Today these networks have their own independent circuit arrangements and terminals to service their user. Very few of these terminals share communication circuits or can access more than one State computer center.

Private circuit facilities are utilized for both voice and data requirements and have been acquired on a gradual basis by Colorado State agencies. These facilities have been provided primarily by Mt. Bell Telephone Company and to a lesser extent by the Division of Communications utilizing State Microwave channels.

Certain State agencies utilizing Mt. Bell facilities were able to obtain State or Federal Telpac circuit groups, thus obtining lower mileage cost for part or all of their circuit requirements. In recent times the State Telpac facilities have been fully consumed and Federal Telpac facilities have gradually been retracted for use by Federal agencies. This has placed individual State agencies in a position where they must pay the full tariff rate especially for new circuits installed during the past two years.

GENERAL APPROACH TO THE STATEWIDE DATA COMMUNICATION PLAN

The independent development of data communications by State agencies make the effort to generate a consolidated statewide network an extremely difficult task. In the data communication planning considerations, every effort will be made to retain as much equipment, program development efforts and their related investments as possible.

When examining potential vendors for hardware and software components for a Statewide network, the systems available must have been proven and operational within operating networks today. Prototype systems will not be acceptable. It is extremely important that each alternative be approached on an informed basis and that selection and development efforts proceed with great care.

The Statewide data communication planning efforts are open to all potential alternatives. Whichever alternatives are reviewed and recommended, the procedure will be to use a phased approach, possibly a pilot project with development phases occuring over several years following the pilot effort.

Statewide Data Communication planning has met with some progress, but planning efforts have not developed to the point where alternatives, recommendations and cost estimates are available. The list of subjects listed below are explained in the remaining pages of this report and represent the status of various study efforts associated with the Statewide data communication planning endeavors.

1. Survey of availability of different communication facilities.

2. Bulk acquisition of current and new circuits.

3. Potential use of technological advances in data communication facilities.

4. Sharing of long distance data circuits.

5. Vendors' technologies to handle a Statewide network.

SURVEY OF THE AVAILABILITY OF DATA COMMUNICATION FACILITIES FOR COLORADO STATE GOVERNMENT REQUIREMENTS

Many new types of data communication facilities have been announced and some have been installed in certain parts of the country. Some of these facilities have been installed in Denver and connects Denver with other large cities, but virtually none of these facilities have been extended into other Colorado communities. Most of the Colorado State Government's data circuit requirements function between Denver and the small Colorado communities and directly between the smaller communities. Very few of these circuits cross the Colorado State border into other States.

During recent surveys and installation efforts the lack of availability of many of the new type of data communication facilities became evident. The results are as follows:

Analog data circuit facilities have been available for many years and is the primary method that is currently in use for providing such services to agencies within Colorado State Government. These services are provided in either dial-up or private line data circuits. Individual circuit speeds range from .3 to 9.6 thousand bits per second. Mt. Bell Telephone currently provides the majority of these analog facilities. New circuits are readily available, normally between 30 to 45 days.

High speed analog circuits are high speed circuits that can transmit at 19.2, 40.8, 50.0, 200.0, 230.4 and 460.8 thousand bits per second. These circuits are configured by combining multiples of the individual analog circuits into a group. These circuits are available between major Colorado communities, but can only be obtained by a special assembly request. Special assembly prices and installation times can vary from 12-52 weeks depending on internal difficulties encountered within Mt. Bell.

Digital Data Service (DDS) is a data circuit facility provided by the Bell System. It allows computer equipment to communicate with terminal equipment entirely in digital mode of transmission without the normal analog conversion operations. Transmission speeds available with DDS are 2.4, 4.8, 9.6 and 56.0 thousand bits per second.

Digital Data Service is currently available only in Downtown Denver. Highspeed digital service (56 kbps) will be available in the eastern suburbs the second quarter of 1980. Expansion of Digital Data Service to other Colorado communities is tentatively scheduled for Colorado Springs for 1981, beyond that no commitment has been made.

T-Carrier service is a recent development that has been made available in Colorado by Mt. Bell. There are four types of T-Carrier services, but only one class of T-Carrier is available in Colorado. This is called T-1 Carrier and transmits at 1.544 million bits per second. Denver proper has T-1 Carrier available, but in limited quantity based on the availability of facilities; such facilities must be requested under a special assembly request. Prices are reasonable and installation wait time is about 26 weeks. T-1 Carrier has a 50 mile maximum limit and is only available within a given exchange area.

Other Common Carrier Facilities including Satellite transmission are available in Denver, but these services are not available to other smaller Colorado communities. Such services are normally connected to the customers' sites by the non-Bell carrier utilizing a Bell System extension circuit. Such an arrangement will not help State agencies since Bell facilities can be obtained from Mt. Bell directly and there is no need for out-of-state circuits.

Satellite Services are available from different satellite companies, but these services again utilize Bell System extension circuits in order to access the customers' site. The satellite transmission technology would require some major conceptual changes in order to provide facilities that would help Colorado State agencies. Small inexpensive transceiver dishes would be required at each State computer and terminal site. Transceivers would be multiplexed so transmission speeds between 2.4 to 56 thousand bits per second could be attained in order to allow computer and terminal equipment to fully utilize such facilities. Current large dishes used in the industry today are considered too expensive to be cost effective for State Government requirements and transmission speeds are too fast to properly service individual terminal locations.

In the forseeable future (2-3 years) the only data communications facilities available to State Government agencies between Denver and other smaller communities will be analog type services. Within the immediate Denver and Colorado Springs exchanges, Digital Data Services and T-1 carriers will be available depending on availability of facilities and will provide an alternative to analog circuits.

Colorado State Microwave currently provides data circuit facilities for four different projects. COTIE is the oldest of these projects and provides access to the computer center at Colorado State University for a number of small colleges. The Department of Highways has a number of engineering terminals utilizing microwave faciiities into Denver. The Department of Institutions interactive terminal network currently is operational into the Institutional Computer Center (ICC) in Pueblo. Corrections is the newest user of the State Microwave facilities; this arrangement provides access into the Administration of Justice Computer Center (AJCC) for terminals located in Colorado Springs and Canon City.

Colorado State Microwave facilities are not used as frequently as Mt. Bell facilities for data purposes due to a number of problems associated with Mt. Bell and the Division of Communications.

Mt. Bell was able to obtain a special tariff (10001 channel) in 1974 from the Colorado Public Utilities Commission that made it a requirement that this special type circuit be installed to connect a private carrier, such as the State Microwave facility, to the Mt. Bell system. This tariff has a number of delays, limitations and cost associated with it that discourages most State agencies from utilizing these State facilities. Some of these are:

1. Maximum mileage which Mt. Bell will provide for the 10001 channel is 25 miles.

2. Lead time to order and install 10001 channels range from 3 to 18 months depending on Mt. Bell's willingness to provide such facilities readily.

3. Engineering and installation cost must be guaranteed in advance before the order is processed through Mt. Bell engineering. Cost of these services has been gradually increased to where a single 10001 channel installation is in the $1200 to $1300 price range.

4. Each such channel is priced under a special assembly arrangement, so the monthly price of such channels can vary; such monthly prices are unknown until the Mt. Bell engineering efforts are completed.

In addition to the problems associated with Mt. Bell Telephone Company and their 10001 channel, the Division of Communications have several inherent problems that affects the same potential users; these problems are:

1. The availability of staff at the Division of Communications for designing acutal microwave projects has been lacking. Microwave projects historically have taken 3-6 months before sufficient lead time allows for actual design.

2. Capital Outlay dollars must normally be provided by the agency requiring the service. In many cases new multiplex cards must be purchased in order to activate a microwave channel.

3. Maintenance of microwave data channels has presented some State agencies with problems in obtaining prompt maintenance service. These problems have occurred in the more remote locations where only minimal communications staff is available and there is a lack of experience and training.

In comparison, when ordering a standard Mt. Bell analog circuit, the design and installation duration takes from 30 to 60 days and an accurate cost can be estimated before ordering. Such facilities can be cancelled after the first thirty days with no capital outlay loss. It is evident why Mt. Bell

facilities are utilized more frequently for data communications circuits.

BULK CIRCUIT ACQUISITION

Of prime importance is a survey taken on analog circuits currently leased from Mt. Bell Telephone Company. The following State agencies were contacted in order to obtain routing and cost information associated with their data and foreign exchange voice analog circuits.

1. Colorado University
2. Colorado State University
3. University of Northern Colorado
4. Department of Revenue
5. Department of Employment
6. Department of Health
7. Department of Institutions
8. Department of Corrections
9. Colorado Bureau of Investigation
10. General Government Computer Center

As of this report, the survey was not yet completed, but an initial review of information indicates an extensive number of analog circuits linking the larger Colorado communities between Pueblo to Ft. Collins. Most of these circuits were acquired for some unique requirement, independent of the needs of other State agencies and many are paid for on an individual basis. This has resulted in paying the highest possible price per mile.

By overlaying routing requirement of each of these circuits, the accumulative independent routing and associated cost appears to be sufficient to justify the expansion and addition of new State Telpac channels. The communities to be connected in this Telpac arrangement would be Pueblo, Colorado Springs, Denver, Boulder, Greeley and Ft. Collins; which are all located on the Colorado Front Range Area.

Telpac channels are provided under tariff classification available to Government agencies where large numbers of circuits are required between two communities. These channels come in four Telpac groupings of 12, 24, 60 or 240 circuits. By acquiring the proper Telpac grouping to fit the circuit requirements between the various communities the monthly mileage cost can be reduced from $4.09 per mile per month for individual circuits to a cost that will range from .25 to $4.00 per mile per month depending on the size of the Telpac acquired and how many of the circuits in this grouping are actually in use. A significant saving is expected to result from such an acquisition in that actual circuit mileage costs are expected to drop into the $1.00 to $1.70 per mile range.

Additional agencies must be surveyed, costs must be verified with Mt. Bell, the actual Telpac channel must be accurately tariffed and compared to current cost. Prospective State agencies with circuits must be contacted as well as

the Division of Communications and Administrative Services Division within the Department of Administration in order to establish an acceptable Telpac billing arrangement. Dollars associated with these Telpac efforts will be within current appropriation requests and produce a significant saving or the project will not be implemented. The recommendations are expected to be completed before June, 1980.

POTENTIAL USE OF TECHNOLOGICAL ADVANCES IN DATA COMMUNICATION FACILITIES

During a study of circuits between Capitol Hill and the computer facilities at the General Government Computer Center, it was discovered that in the immediate Denver Metropolitan area that Mt. Bell will have available in the near future two of their more advanced data channels. These two services are called Digital Data Service (DDS) and T-1 Carrier services. Both services can provide highspeed data transmission between terminal locations in the Capitol Hill area and the General Government Computer Center (GGCC) at reasonable cost. Currently there are 32 analog circuits operating between Capitol Hill Terminal locations and GGCC, monthly cost attributed to these circuits is $4,798.

If two high speed 56.0 Kbps digital channels, and related secondary circuits and equipment were to be installed to substitute the current circuit arrangements, a $447 per month savings would occur. Such high speed 56.0 Kbps digital channels will be available during the second quarter of 1980.

If a T-1 carrier channel (1.544 Kbps) and related secondary circuits and equipment were to be installed to substitute the current circuit arrangement a $631 per month savings would occur. There is a 26 week delivery delay, plus a $10,300 declining termination liability (for 10 years period) associated with this type of circuit.

A final review and recommendation will be made by June, 1980.

SHARING OF LONG - DISTANCE DATA CIRCUITS

Long-distance analog circuits are costly and in a number of cases a single computer center needs multiple numbers of such circuits to particular cities in order to service multiple numbers of users. Such is the case for circuits that are at the General Government Computer Center for the cities of Pueblo and Colorado Springs. Sharing of a high speed analog circuit can be easily achieved with todays technology. Such an arrangement can handle up to four 2.4 Kbps sub-channels operating simultaneously on a single high-speed channel.

There is an immediate need in both Pueblo and Colorado Springs for multiple circuits which would service such activities as: The State Personnel and Accounting Systems; the Social Services and Rehabilitiation offices need access to their records at GGCC; the higher education accounting system to be implemented for Otero Junior College, Trinidad State Junior College, Pikes Peak Community College and Pueblo Vocational Community College need access to their accounting records contained at GGCC.

Such an arrangement is currently in the planning and cost comparison stage and is expected to be implemented in conjunction with the bulk circuit acquisition endeavor.

VENDORS' TECHNOLOGIES TO HANDLE A STATEWIDE NETWORK

A variety of Vendors claim to have techniques which can provide hardware and software methods that can support statewide network requirements. Some of these techniques have been implemented and tested with actual customer accounts, some techniques are under development while still others are in the planning stages.

Vendors that provide network type services are grouped into three categories, First, there are the computer vendors and the techniques developed for their design philosophies. These techniques are designed primarily to function with their computer and terminal equipment. Little effort has been expended by this category of vendors to provide network techniques to support a mixed computer center environment such as exists within Colorado State government. The second category of vendors are the common carriers. Most of these vendors provide network services based on actual time used on their networks. Unfortuantely most of these vendors only service major cities such as Denver, not the outlying communities of Colorado. American Telephone and Telegraph has in the planning and development stage a product called Advanced Communication Service (ACS), but difficulties and delays have occurred and the availability of this product for Colorado communities can not be expected for at least 5 years. The third category of vendors are the non-computer vendors. These vendors are attempting to provide intelligent type networks that can interface mixed terminal and computer equipment, utilizing private circuits in a network arrangement.

Some of these vendors have been interviewed to discuss their product line and capabilities as related to a possible Statewide Colorado State Government network. Several vendors show possible potential, but additional investigation will be required before vendors with the greatest potential can be determined.

EXHIBIT C

FORMAT FOR
Agency and Computer Center ADP Plans

This procedure was developed to provide a consistent format for agencies to use in preparing their annual ADP Plans. It also provides a consistent format for computer centers that service these agencies to follow in submitting their Center's annual ADP Plans.

EXHIBIT C

AGENCY AND COMPUTER CENTER ADP PLANS

The occurrance of consolidation of computer centers indicates a need to revise the previous concept of agency ADP planning. In the past, each agency planned, almost independently, for its own ADP support and submitted its plans directly to the Division of ADP. In the future, more coordinated planning amont an agency and its supporting computer centers will be increasingly appropriate.

Beginning in calendar year 1979, the Division of ADP will require an agency ADP plan from each of the agencies listed in TAB 1. The agencies' plans must be received by April 1 and must contain the information indicated in "Format for Agency Plan," below. If an agency's plan has not changed since the previous year, send a copy of the previous year's plan with a cover letter describing the case. The Division of ADP will provide the appropriate agency plans and coordinating instructions to the manager of each supporting center by April 30. Subsequently, each supporting computer center listed in TAB 2 will prepare a computer center plan. The computer center plan must contain the information indicated in "Format for Computer Center Plans," below, and will be provided to the Division of ADP by June 15.

The objectives of the above schedule are:

1. To allow for adequate planning and dissemination of agency and computer center plans prior to preparation of budget request.

2. To provide time to the Division of ADP to formulate the ADP Master Plan and budget recommendations for the Governor, the Office of State Planning and Budgeting and the Joint Budget Committee.

FORMAT FOR AGENCY PLANS

SECTION I: Management Summary

SECTION II: Current Status

- Description of current applications by: supporting State computer center, on-site processor, or contract support facility.
- Description of current data communications requirements.
- Problems

SECTION III: Planned Enhancements to Current Applications

- Description and justification
- Estimated transaction volume change
- Description of reports to be added/deleted
- Estimated effect on current data communications requirements
- Recommendations to State Computer Centers to provide for the planned enhancements

SECTION IV: Planned New Applications

- Description and justification
- Schedule/dates
  1. Development
  2. Test
  3. Operational
- Estimated transaction volume
- Estimated file storage requirements
- Recommendations to supporting computing activity

SECTION V: Resource Requirements

- Personnel
  1. An organization chart of the agency's ADP function showing numbers of personnel by job classification
  2. New requirements that will be requested in next budget request
  3. Special education or training required
  4. Projected requirements (beyond the next budget request) and the estimated fiscal years of the requirements

- Hardware

  1. Additional on-site equipment (including terminals) to be requested in the agency's next budget request, and justification

  2. Recommended additions that might be budgeted by computer centers for support of the agency (NOTE: No list of current equipment is required if the agency has reviewed and updated the inventory provided by the Division of ADP)

- Software

  1. Software required but not available to the agency either on-site or at the supporting computer. Location(s) where the software is required.

- Communications

  1. Additional or changing communication lines and modem requirements

- Other Special Requirements

SECTION VI: Benefits

- A description of the benefits, savings, and cost avoidance that are to be realized as a result of implementing this agency plan

SECTION VII: Other Recommendations

- Any specific recommendations to the Division of ADP or supporting computer centers that may improve the agency's ADP function or support of the agency.

FORMAT FOR COMPUTER CENTER PLANS

SECTION I: Management Summary

SECTION II: Current Status

- Description of current applications, by agency, that are supported by the center
- Current equipment inventory
- Current utilization (Use illustration as in TAB 3)
- Current data communications schematic(s)
- Problems

SECTION III: Workload

- Applications, by agency, requiring additional support
- Other enhancements required that are not related directly to a specific application; e.g., normal growth, technological change, etc.
- Effect on resources (Use illustration as in TAB 3)

SECTION IV: Short-term (priority) Requirements

- Agencies and their applications that justify the priority

SECTION V: Resource Requirements

- Personnel
  1. An organization chart of the computer center showing the number of personnel by job classification
  2. New requirements that will be requested in next budget request
  3. Special education or training required
- Hardware
  1. Additional equipment (including terminals) to be requested in next budget request, and justification

- Software
  1. Recommended software changes
- Communications
  1. Additional or changing communications lines and modems
- Facilities
  1. Comments on adequacy of existing facilities
  2. Recommended changes
- Other Resources

SECTION VI: Benefits

- A description of specific benefits, savings, and cost avoidance to be sought during the budget year

SECTION VII: Other Recommendations

- Any specific recommendations to the Division of ADP

TAB 1

AGENCIES SUBMITTING ADP PLANS

Department of Administration

Division of Accounts and Controls

Division of ADP

Division of Communications

Division of Purchasing

Department of Agriculture

Department of Corrections

Department of Education

Office of the Governor

Department of Health

Department of Highways

Department of Institutions

Judicial Branch

Department of Labor and Employment

- Division of Labor
- Division of State Compensation
- Division of Employment

Department of Law

Legislative Branch

- Bill Drafting
- Legislative Council
- General Assembly
- Joint Budget Committee
- Office of State Auditor

Department of Local Affairs

- Division of Property Taxation
- Division of Planning
- Division of Criminal Justice

Department of Military Affairs

Department of Personnel

Department of Natural Resources

Department of Regulatory Agencies

- Division of Insurance

Department of Social Services

Department of State

Office of State Planning and Budgeting

Department of Treasury

Adams State College

Arapahoe Community College

Colorado School of Mines

Community College of Denver

Fort Lewis College

Lamar Community College

Mesa College

Metropolitan State College

University of Northern Colorado

Otero Community College

University of Southern Colorado

Trinidad State Junior College

Western State College

TAB 2

SUPPORTING COMPUTER CENTERS

General Government

Revenue

Administration of Justice

Labor/Employment

University of Colorado

EXHIBIT C

Colorado State University

TAB 3

HARDWARE UTILIZATION

The current and projected utilization of computer resources should be shown for the current and each future year covered by the plan. Include resource requirements for:

1. Current needs

2. Anticipated growth (volume)

3. New and revised applications

All requirements are measured against existing capacity for each resource shown. Resources should include such components as: CPU cycles, disk storage capability, memory capacity, and channel availability.

The following chart should be completed for each of the five planning or projected years. The chart is an example of the resources which should be included. The resources which should be included will vary depending upon your computer configuration and applications.

FY 19__ - 19__

DESCRIPTION	CPU	MEMORY	DISK ACCESS CHANNEL 1	DISK STORAGE	TAPE ACCESS CHANNEL 2	PRINTER
Current	75	100	80	160	50	50
Growth	10	10	20	30	0	5
New	10	10	10	10	0	5
TOTAL	95	120	110	200	50	60
Capacity	90	90	50	85	50	90
Excess or (Deficiency)	(5)	(30)	(60)	(115)	0	30

Figures are percent of full capacity.

EXHIBIT D

Major Planned Activities Implementation Schedule

This chart depicts a proposed schedule for implementing the major 1980 ADP Master Plan recommendations and activities over the next 4 years.

EXHIBIT D

MAJOR PLANNED ACTIVITIES IMPLEMENTATION DIAGRAM

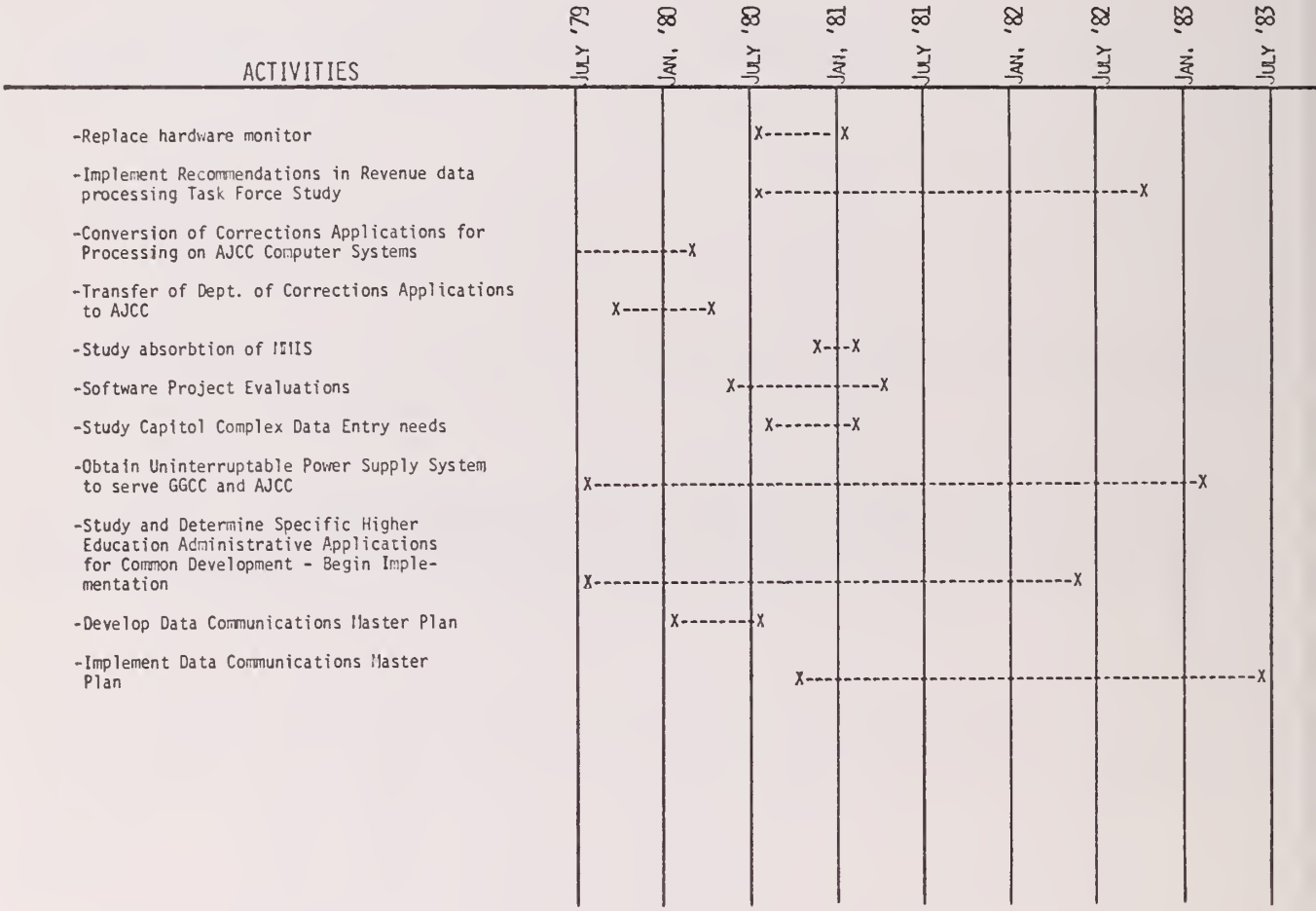


EXHIBIT E

CONTENTS OF REFERENCE LIBRARY

Located at the Division of ADP

- Auerbach Computer Technology Reports

Volume	Title
600-605	Computer System
606	Small Business Computers
607-608	Minicomputers
609-610	Peripherals
611	Microform
612	Applications Software
613	Systems Software
614	Data Communications Equipment
615	Data Communications Terminals
616	Computer Terminals
617	Time Sharing

- Auerbach Data Processing Manual (2 Volumes)
- Auerbach Data World

Volume	Title
1	Master Contents Index, General Purpose Computers
2	Business Minicomputers, General Purpose Minis
3	Peripherals, Data Handling, Application Software, Systems Software
4	Data Communications

- Auerbach Minicomputer Reports (2 Volumes)
- Auerbach I/O Reports (3 Volumes)
- Auerbach EDP Auditing Manual (1 Volume)
- Datapro-70 (3 Volumes)

- Datapro-40 Features & Surveys (1 Volume)
- Datapro-EDP Solutions (2 Volumes)
- Datapro Directory-Software (2 Volumes)
- Datapro-Data Communications (3 Volumes)
- Datapro-Solutions/Communications (2 Volumes)
- Datapro-Reports on Minicomputer (2 Volumes)
- Applied Computer Research

  EDP Performance Management Handbook

Volume	Title
1	Audit and Control
2	Tools and Techniques

- An Introduction to Software Physics by Institute for Software Engineering

[1]Frederic G. Withington, "IBM's Future Large Computers," Datamation, July, 1978, p. 116.

[2]Ibid.

[3]Pendar M. McCarter, "Where is the Industry Going," Datamation, February, 1978, p. 99.

[4]Douglas Comer, "Is It Time For A Change In Language Design?", ICP Interface Data Processing Management, Fall, 1979, p. 15.